

# THE FUTURE ROLE OF THE CADASTRE

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## SUMMARY

An important component of all nation states is building and maintaining a cadastral infrastructure. This includes cadastral surveys to identify and subdivide land, land registry systems to support simple land trading (buying, selling, mortgaging and leasing land) and land information systems to facilitate access to the relevant information increasingly through a web enabled e-government environment. For many cadastral officials and for much of society, this is the primary, and in many cases the only role of the cadastre. However the potential and role of the cadastre has rapidly expanded over the last couple of decades.

Most governments assume that the primary task of this cadastral infrastructure is to support the operation of an efficient and effective land market. But what is a land market in a modern economy? Since our cadastral systems were invented, land commodities and trading patterns have undergone substantial changes: they have become complex, corporatised and international. Are our current cadastral systems designed to support a modern land market that trades in complex commodities such as mortgage backed certificates, water rights, land information, time shares, unit and property trusts, financial instruments, insurance products, options, corporate development instruments and vertical villages? Modern land markets involve a complex and dynamic range of activities, processes and opportunities and are impacted upon by a whole new range of restrictions and responsibilities now being imposed on land. They are continually evolving, primarily in response to economic energy and sustainable development objectives. They are also being driven by information and communications technologies.

While modern land markets offer almost unlimited opportunities for cadastral systems to expand their relevance and usefulness, one commodity in particular - land information - has the ability of transforming the way both governments and the private sector in modern economies do business. The e-land administration concept as part of e-government initiatives is now being replaced by *iLand* – a new vision for spatially enabled land information. While the original purpose of cadastres was essential and useful in facilitating simple land trading to support expanding economies, and modern land markets with their complex commodities offer potential opportunities to take another leap forward, it is the land information derived from the cadastre that has the potential to transform the way modern societies function. It has the potential of transforming how tax is collected, how health services are delivered, how the environment and our cities are managed, how we respond to emergencies and terrorism, how wars are fought and how elections are run. Linked to such transformational technologies such as Google Earth and Microsoft's Virtual Earth, cadastral information has the potential for spatially enabling government (and society).

This paper argues that there are considerable, virtually untapped benefits to be gained if modern cadastres focus on supporting modern land markets. However it is the opportunities offered by cadastral information and *iLand* that have the potential to far surpass the benefit and impact of the original purpose for which cadastres were built and possibly even the potential benefits offered by modern land markets.

The challenge now rests with cadastral administrators around the world to capitalise on the opportunities provided by modern land markets and *iLand* – are they up to the task?

## **INTRODUCTION**

Land surveyors and cadastral administrators are experts in designing, building and managing the spatial component of our cadastres as the central component of land administration systems (LAS). They are experienced in creating, describing and defining land parcels and associated rights and restrictions. Historically, the primary reason that society requires these skills is to support an efficient and effective land market in which the rights in land are traded to promote economic development. By the mid nineteenth century, trading involved buying, selling, mortgaging and leasing of land. By the mid twentieth century, we as professionals, along with land administration and cadastral officials and associated legal professionals, assumed that we understood land markets and that we had developed appropriate professional skills to serve the needs of those markets.

Unfortunately these professionals were involved in supporting the land trading activities, not designing them. Simply there is little documentation in the literature on how to design and build a land market or even on the development and growth of land markets (however see Wallace and Williamson, 2005a).

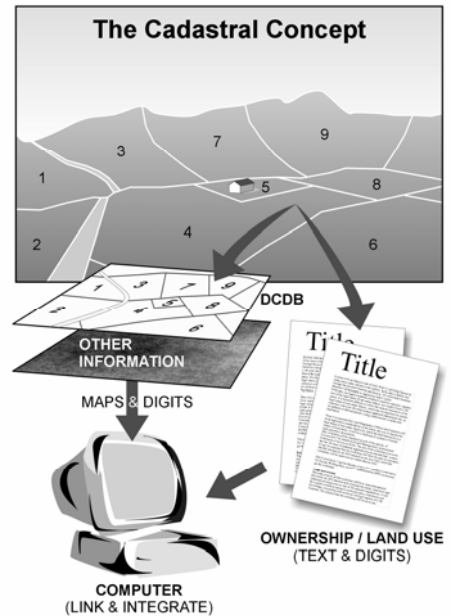
It is ironic that surveyors pride themselves on working from the “whole to the part”, yet in the case of land markets there is little effort given to designing land markets and then designing the cadastre and supporting spatial skills to support them. Historically, we went the other way round: the market required commodified land parcels and we defined them.

Our current cadastral skills are appropriate for simple land markets where the focus is traditional land development and simple land trading; however land markets evolved dramatically in the last 50 years and became very complex, with the major wealth creation mechanisms focused on the trading of complex commodities. As with simple commodities such as land parcels, all commodities require quantification and precise definition (de Soto, 2000). While land surveyors and cadastral administrators have not embraced the administration of complex commodities to a significant degree, these modern complex land markets offer many opportunities for surveyors and cadastral administrators if they are prepared to think laterally and capitalise on their traditional measurement and land management skills.

While the expansion of our cadastres to support the trading of complex commodities offers many opportunities for surveyors and cadastral administrators, it is one particular commodity - land information - that has the potential to significantly change the way societies operate and how governments and the private sector do business.

This paper argues that the growth of markets in complex commodities is a logical evolution of our people to land relationship and the evolving cadastral and land administration systems. It proposes that the changing people to land relationships, the need to pursue sustainable development and the increasing need to administer complex commodities within an ICT (information and communications technologies) enabled virtual world, offer new opportunities for our cadastral systems. However if these opportunities are to be achieved then there are many challenges to be overcome.

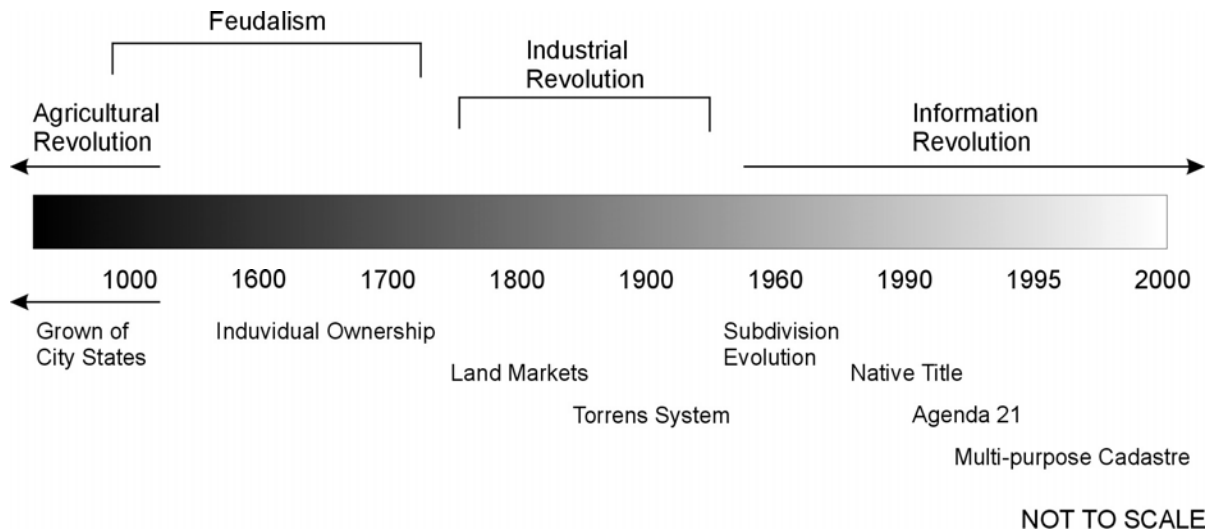
The paper draws upon current research that is being undertaken within the Centre for Spatial Data Infrastructures and Land Administration, Department of Geomatics, University of Melbourne ([http://www.geom.unimelb.edu.au/research/SDI\\_research/](http://www.geom.unimelb.edu.au/research/SDI_research/)) to better understand and address these challenges. This includes the need for a collaborative whole of government approach to managing spatial information using spatial data infrastructure principles, the need to better understand the role that the cadastre plays in integrated land management (land markets, land use planning, land taxation etc), the need to seamlessly integrate built and environmental spatial data in order to deliver sustainable development objectives, the need to improve interoperability between our land information silos through e-land administration, the need to better manage the complex issues in our expanding multi-unit developments and vertical villages, the need to better manage the ever increasing restrictions and responsibilities relating to land and the need to incorporate a marine dimension into both our cadastres and land administration systems. All these initiatives come together to support a new vision for managing land information - *iLand*.



**FIGURE 1**  
**The Cadastral Concept**  
(FIG, 1995)

## EVOLUTION OF LAND ADMINISTRATION SYSTEMS

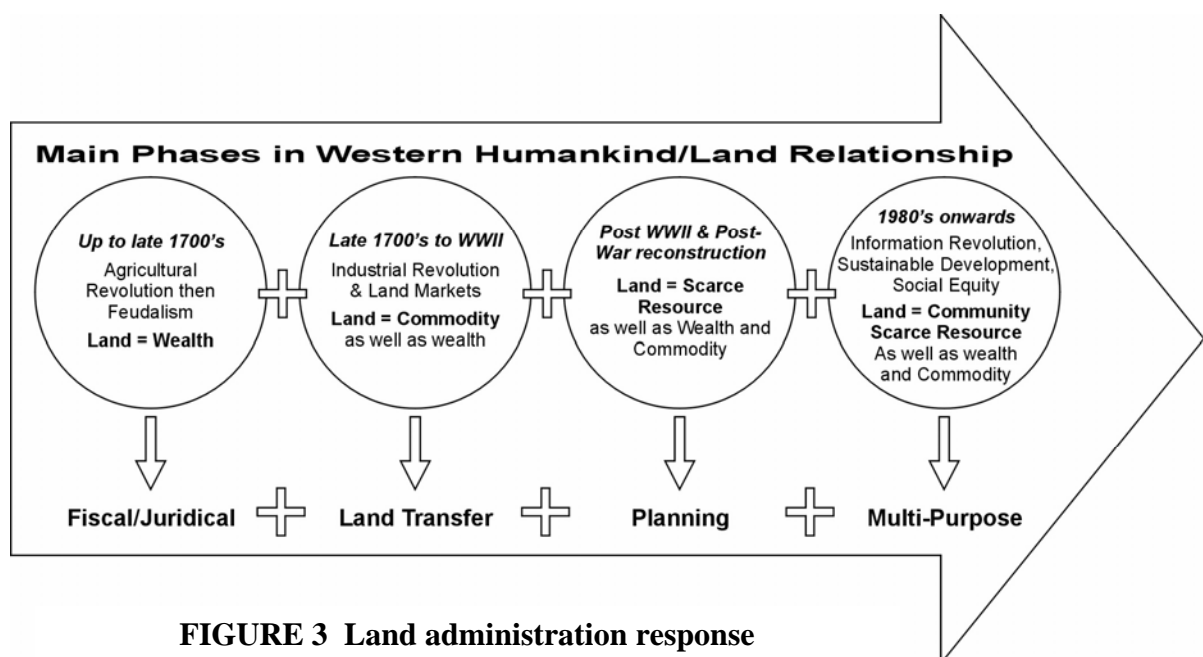
The cadastral concept shown in Figure 1 (FIG, 1995) is simple and clearly shows the textual and spatial components, which are the focus of land surveyors land registry and cadastral officials. However while the cadastral concept is simple, implementation is difficult and complex. While this model is still a useful depiction of a cadastre, it does not show the evolving and complex rights, restrictions and responsibilities that a modern society demands in order to deliver sustainable development objectives. It also does not show the important role the cadastre plays in supporting integrated land management or in providing critically important land information that plays a key role in enabling the creation of a virtual society and at a more practical level e-government.



**FIGURE 2 Evolution of people to land relationship**  
(Ting and Williamson, 1999a)

To understand this evolution it is worth considering the changing people to land relationship over the centuries. Even though Figure 2 depicts a Western example of this evolving relationship, a similar evolution can be plotted for all societies. This diagram highlights the evolution from feudal tenures, to individual ownership, the growth of land markets driven by the Industrial Revolution, the impact of a greater consciousness about managing land with land use planning being a key outcome, and in recent times the environmental dimension and more recently the social dimension in land (Ting and Williamson, 1999a). Historically an economic paradigm drove land markets however this has now been significantly tempered by an environmental and more recently a social paradigm. Simply the people to land relationship in any society is not stable but is continually evolving.

In turn most civilisations developed a land administration or cadastral response to this evolving people to land relationship. Figure 3 depicts the evolution of these cadastral responses over the last 300 years or so in a western context. The original focus on land



**FIGURE 3 Land administration response**  
(Ting and Williamson, 1999a)

taxation expanded to include support for land markets, then land use planning and over the last decade or so has expanded to provide a multi-purpose role to support sustainable development objectives (Ting and Williamson, 1999b).

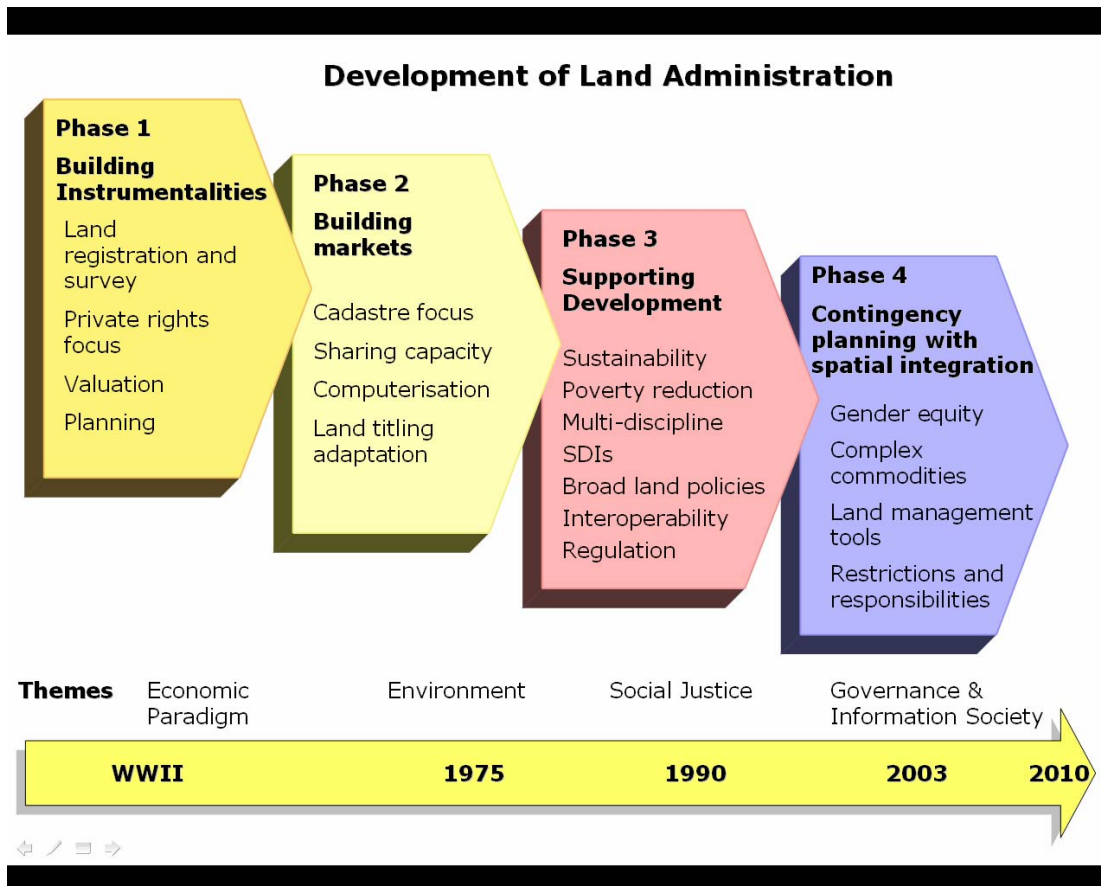
Even considering this evolution current land administration systems are still based on a 19<sup>th</sup> century economic paradigm with the objective to define simple land commodities and to support simple trading patterns (buying, selling, leasing and mortgaging), particularly by providing a remarkably secure parcel titling system, an easy and relatively cheap conveyancing system, and reliable parcel definition through attainable surveying standards.

Arguably, Australia led the world in adapting their LAS to support land parcel marketing. Major innovations of the Torrens system of land registration and strata titles are copied in many other countries. However, because of the pace of change, the capacity of LAS to meet market needs has reduced. The land market of say 1940, is unrecognisable in today's modern market. After WW II new trading opportunities and new products were invented. Vertical villages, time shares, mortgage backed certificates used in the secondary mortgage market, insurance based products (including deposit bonds), land information, property and unit trusts and many more commodities now offer investment and participation opportunities to millions either directly or through investment or superannuation schemes. The controls and restrictions over land have become multi-purpose, and aim at ensuring safety standards, durable building structures, adequate service provision, business standards, social and land use planning, and sustainable development. The replication of land related systems in resource and water contexts is demanding new flexibilities in our approaches to administration (Wallace and Williamson, 2005b).

Australian LAS that service parcel based trading and related market activities were overhauled in the 30 years commencing in 1970 to:

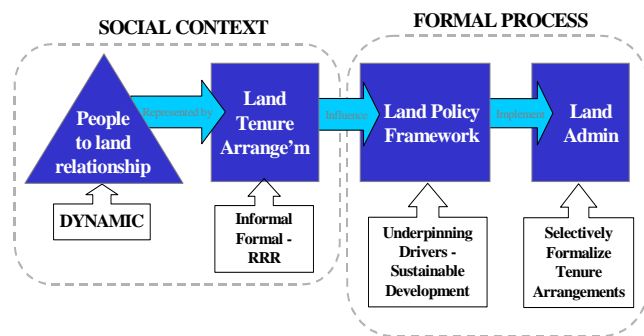
- comply with National Competition Policy
- reorganise the 19<sup>th</sup> century legislative structures establishing single office - single function administrations (Surveyor General, Registrar General, Valuer General) with modern management and performance enhanced organisational structures
- provide opportunities for more competitive professional services and private sector involvement, and
- capitalize on opportunities available from digital and web technologies.

The combination of new management styles, computerization of activities, creation of databanks containing a wealth of land information, and improved interoperability of valuation, planning, address, spatial and registration information allowed much more flexibility. However, Australian LAS remain creatures of their history of state and territory formation. They do not service national level trading and are especially inept in servicing trading in new commodities. However modern societies, which are responding to the needs of sustainable development, are now required to administer a complex system of overlapping rights, restrictions and responsibilities relating to land – our current land administration and cadastral systems do not service this need. A diagrammatic representation of the development of land administration (and cadastral) systems from a policy focus is shown in Figure 4.



**Figure 4 Development of Land Administration** (Wallace and Williamson, 2005c)

Modern societies are also now realising that there are many rights, restrictions and responsibilities relating to land, which exist but have not been formalised by governments for various policy or political reasons. This does not mean these rights do not exist but that they simply have not been formalized in recognizable land administration



**FIGURE 5 Formalisation of tenures** (Dalrymple, Wallace and Williamson, 2004)



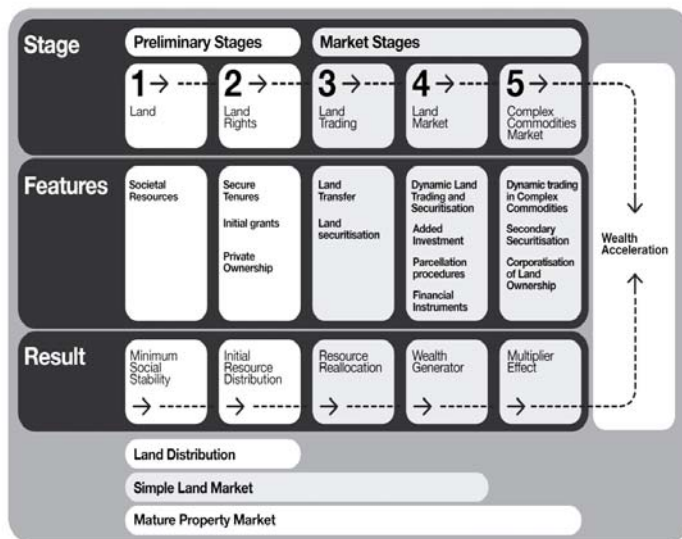
**FIGURE 6 Land Administration Arrangements** (Enemark, Williamson and Wallace, 2005)

frameworks. A good example is the recognition of indigenous aboriginal rights in land in Australia in the 1980s. Prior to the Mabo and Wik decisions and the resulting legislation in Australia, indigenous rights did not formally exist. Their existence was informal but strongly evidenced by song lines, cultural norms and other indigenous systems, a situation still familiar

in the developing world where indigenous titles await more formal construction.

The process of formalising tenure and rights, restrictions and responsibilities in land is depicted in Figure 5. An understanding of both formal and informal rights is important as we move to develop land administration and cadastral systems that are sensitive to sustainable development objectives. Additionally, we need to recognize that change management processes and adaptation of formal systems always lag behind reality: all mature systems will simultaneously sustain both informal and highly formalized rights because the systems are not yet ready for emerging interests. Frequently, some rights will be deliberately held in informal systems: one of the largest and most significant management tools in Australia, the trust, remains beyond the land administration infrastructure and involves utilization of paperwork generated by lawyers and accountants and held in their filing drawers.

Other rights involve minimal formalization for different reasons. Residential leases, too common and too short term to warrant much administrative action, are traditionally organized outside LAS. That these land rent-based distribution systems remain potentially within the purview of modern LAS policy makers and administrators is illustrated by Australia’s development of a geo-referenced national address file (GNAF). Indeed the development of spatial, as distinct from survey, information provides the timeliest reminder that information about land is potentially one of the most remarkable commodities in the modern land market. Certainly this commodity of information is of core interest to cadastral administrators.



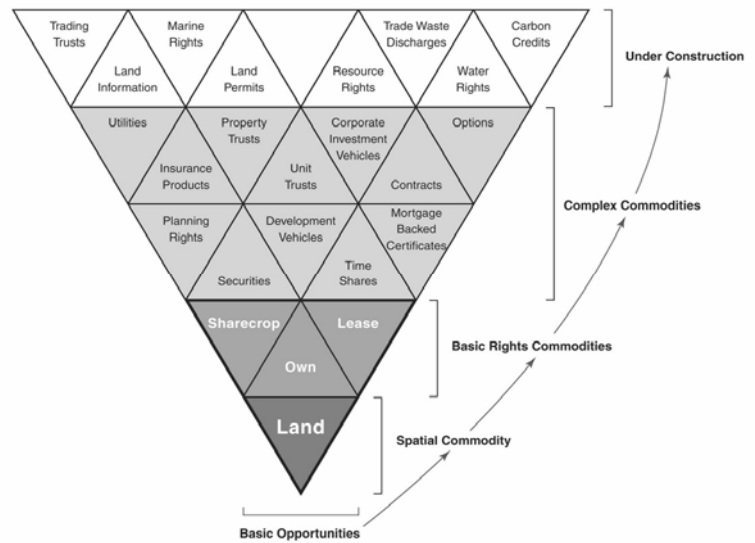
**FIGURE 7 Evolution of land markets**  
(Wallace and Williamson, 2005a)

shows the various stages in the evolution of land markets from simple land trading to markets in complex commodities. The growth of a complex commodities market showing examples of complex commodities is presented diagrammatically in Figure 8.

An integrated model for a modern land administration system (Enemark *et al*, 2005) that draws on the above principles is shown in Figure 6. Even this can go further. Modern land markets have evolved from systems for simple land trading to trading complex commodities such as mortgage backed certificates, water rights and carbon credits. Our understanding of the evolution of land markets is limited but it must be developed if cadastral administrators are going to maximise the potential of trading in complex commodities by developing appropriate land administration systems (Wallace and Williamson, 2005a). Figure 7

## THE ROLE OF THE CADASTRE IN SUPPORTING iLAND

This brief review of the evolution of land administration systems and land markets shows that the traditional concept of cadastral parcels representing the built environmental landscape is being replaced by a complex arrangement of over-lapping tenures reflecting a wide range of rights, restrictions and responsibilities and that a new range of complex commodities building on this trend have emerged. To a large extent these developments are driven by the desire of societies to better meet sustainable development objectives. There is no reason to believe that this trend will not continue as all societies better appreciate the needs to manage the environment for future generations and deliver stable tenure and equity in land distribution.



**FIGURE 8 Complex commodities market**  
(Wallace and Williamson, 2005a)

While the growth of complex commodities offers huge potential for cadastral systems to play a greater role in delivering sustainable development objectives and supporting the trading of these complex commodities in particular, it is one complex commodity, land information, that offers the potential for transforming the way government and the private sector do business. The potential offered by land information in a virtual world in spatially enabling government is so large it is difficult to contemplate. We are starting to glimpse this potential in such initiatives as Google Earth and Microsoft’s Virtual Earth, but this is barely a start. These predictions of the importance of spatial information are also recognized in many other influential forums such as in the prestigious journal NATURE and recently in the Australian Prime Minister’s statement on frontier technologies for building and transforming Australia’s industries (December, 2002) – both these examples place the growth and importance of the geosciences alongside nanotechnology and biotechnology as transformational technologies in the decade ahead.

With regard to the importance and growth in land administration and its cadastral core as shown in Figure 4, Figure 9 attempts to show through a technology focus, how land administration and cadastral systems have been transformed over the last three decades or so. The figure shows five stages in the evolution of our cadastral systems from a technology perspective. The first stage recognizes that historically cadastral systems were manually operated with all maps and indexes hard copy. At this stage the cadastre focused on security of tenure and simple land trading. The 1980s saw the computersiation of these cadastral records with the creation of digital cadastral data bases (DCDBs) and computerized indexes. However this computerization did not change the role of the cadastre or change however it was a catalyst to start institutional change world wide where the traditionally separate functions of surveying and mapping, cadastre and land registration started coming together.



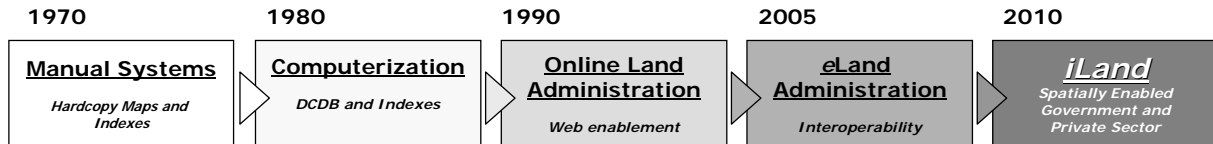


FIGURE 9 Technical evolution of land administration

With the growth of the Internet, the 1990s saw governments start to web enable their land administration systems as they became more service oriented. As a result it became possible to access cadastral maps and data over the web, it facilitated digital lodgment of cadastral data and opened up the era of e-conveyancing. However the focus on security of tenure and simple land trading within separate institutional data silos still continued. At the same time this era also saw the establishment of the spatial data infrastructure (SDI) concept (see Williamson et al, 2003 and Rajabifard et al, 2005). The SDI concept, together with web enablement, started to see the integration of different data sets (and particularly the natural and built environmental data sets) with these integrated data sets now considered critical infrastructure for any nation state.

At the present time there is a significant refinement of web enabled land administration systems where the common driver is interoperability between disparate data sets which is being facilitated by the partnership business model. This is now the start of an era where basic land, property and cadastral information is now being used as an integrating technology between many different businesses in government such as planning, taxation, land development, local government. Examples of this are the new Shared Land Information Platform (SLIP) being developed by the state Government of Western Australia (Searle and Britton, 2005). A key catalyst for these developments is also the development of high integrity geocoded national street address files such as the Australian GNAF (Paull and Marwick, 2005). These developments have also been a catalyst for the development of “mesh blocks” which are small aggregations of land parcels which are now revolutionizing the way census and demographic data is collected, managed and used (Toole and Blanchfield, 2005). This era has also offered the potential for better managing the complex arrangement of rights, restrictions and responsibilities relating to land which are essential to achieving sustainable development objectives (Bennett et al, 2005). This is also driving the re-engineering of cadastral data models which will facilitate interoperability between the cadastre, land use planning and land taxation for example (Kalantari et al, 2005).

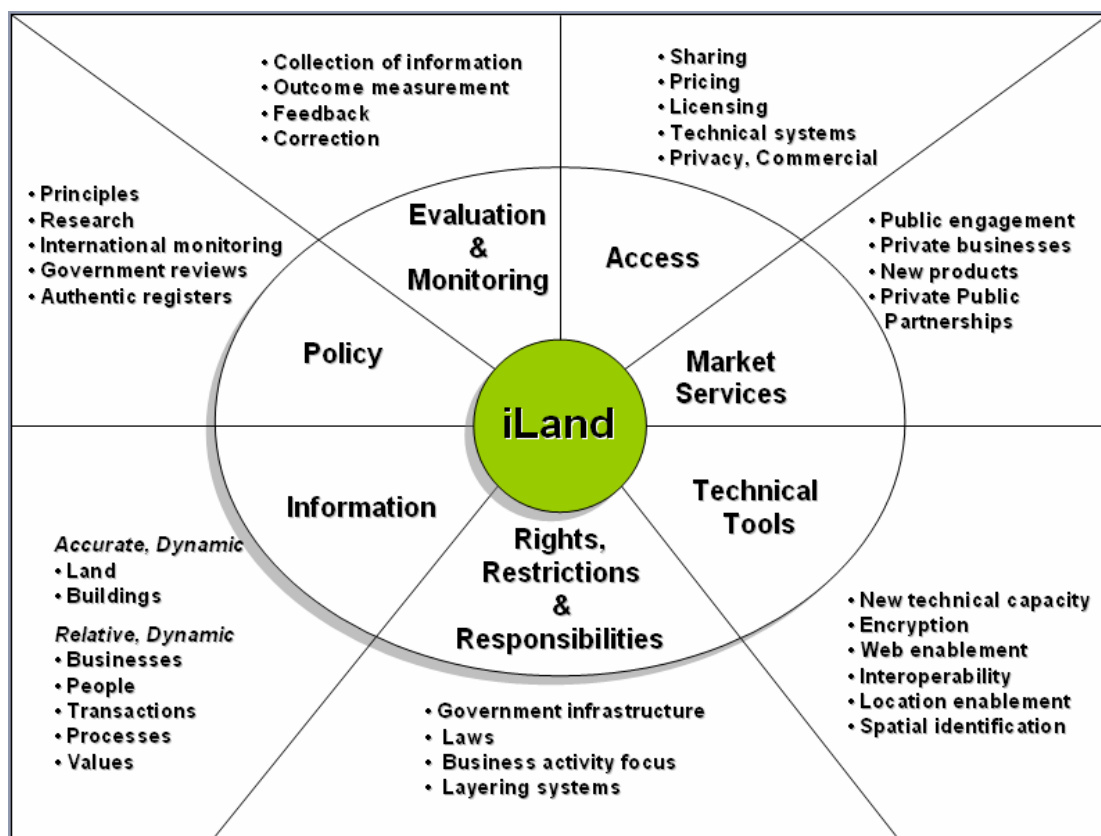
This is now the start of an era where the potential of land and cadastral data has started to be realized. What this era has shown is that the use and potential of cadastral data as an enabling technology or infrastructure outweighs its value to government from supporting simple land trading and security of tenure. It is also the start of an era when governments now realize that the cadastre does not stop at the waters edge. Cadastres must include a marine dimension where there is a continuum between the land and marine environments. It is now recognized that without such basic infrastructure the management of the exceptionally sensitive coastal zone is very difficult if not impossible (see Strain et al, 2005).

However this is not the end of the story – researchers, practitioners, big business and government are now seeing the huge potential from linking “location” or the “where” to most activities, policies and strategies, just over the horizon. Companies like Google and Microsoft are actively negotiating to gain access to the world’s large scale built and natural environmental data bases. In Australia they are negotiating to get access to the national

cadastral and property maps as well as to GNAF. At the same time new technologies are being built on top of these enabling infrastructures such as the Spatial Smart Tag which is a joint initiative in Australia between government, the private sector and Microsoft (McKenzie, 2005). We are starting to see the realization that cadastral and land related information will dramatically spatially enable both government and the private sectors, and in fact society in general. In the near future spatially enabled systems will underpin health delivery, all forms of taxation, counter-terrorism, environmental management, most business processes, elections and emergency response for example.

This will be the era when cadastral data is information and a new concept called iLand will become the paradigm for the next decade. iLand is a vision of integrated, spatially enabled land information available on the Web. iLand enables the “where” in government policies and information. The vision as shown diagrammatically in Figure 10 is based on the engineering paradigm where hard questions receive “designed, constructed, implemented and managed” solutions. In iLand all major government information systems are spatially enabled, and the “where” or location provided by spatial information are regarded as common goods made available to citizens and businesses to encourage creativity, efficiency and product development. The cadastre is even more significant in iLand. Modern land administration demands a cadastral infrastructure as the fundamental of land information capable of supporting those “relative” information attributes so vital for land registries and taxation.

While future markets of complex commodities will continue to rely on the underlying cadastre and land administration system, how many surveyors and cadastral administrators will embrace the definition and management of complex commodities that do not rely on the traditional cadastral boundaries and that require merging of value, building purpose, land use and personal owner information? How many cadastral administrators are capable of seeing the international context of land information and its importance to their national government in presentation of its investment face to the world? Will they embrace iLand?



**Figure 10 The iLand vision** (Wallace and Williamson, 2005)

## CONCLUSION

This paper attempts to show that the people to land relationship is dynamic with the result that the land administration and cadastral response to managing this relationship is also dynamic and continually evolving. A central objective of the resulting land administration systems is to serve efficient and effective land markets. Because of sustainable development and technology drivers, modern land markets now trade in complex commodities, however our current land administration systems and the majority of the skills of land surveyors and cadastral administrators are focused on the more traditional processes supporting simple land trading. I believe the growth in complex commodities offers many opportunities for cadastral administrators if they are prepared to think laterally and more strategically.

The paper then focuses on one particular complex commodity, land or cadastral information, and shows how it has grown in importance over the last few decades to be now considered more important and useful to government than the traditional role of supporting security of tenure and simple land trading. The paper shows that land administration and cadastral systems are evolving into a new vision and essential infrastructure called iLand that spatially enables government and provides the “where” for all government decisions, policies and implementation strategies.

The paper presents a challenge to cadastral officials to design and build modern land administration and cadastral systems that will better support the creation, administration and

trading of complex commodities and particularly use land information to spatially enable not only government but society in general. Unfortunately without these systems modern economies will have difficulty meeting sustainable development objectives and achieving their economic potential.

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